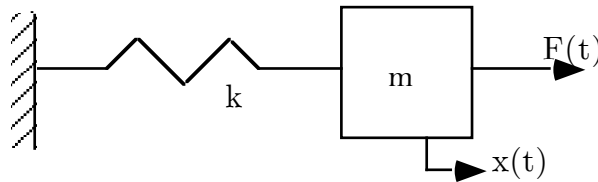


ME 460/660, Mechanical Vibration

Prerequisite topic exam, 1999

1. Solve for $x(t)$ in the following: $10\ddot{x} + 10x = 0$, given $x(0) = 1$, $\dot{x}(0) = 0$.
2. Solve for $x(t)$ in the following: $\dot{x} + x = t$, where the initial displacement is zero.
3. Derive the equation of motion of the following:



4. Find the Laplace domain representation of the solution for $x(t)$ of the differential equation $\ddot{x} + 0.1\dot{x} + 4x = \sin(3t)$ given that $\mathcal{L}(\sin(t)) = \frac{a}{s^2+a^2}$.
5. Find the first term of the Fourier series of the repeating function for which $x(t) = 1$ from $t = 0$ to $t = 1$, and $x(t) = -1$ from $t = 1$ to $t = 2$, repeating every 2 seconds.

Hint:

$$F(t) = \frac{a_0}{2} + \sum_{n=1}^{\infty} (a_n \cos(n\omega_T t) + b_n \sin(n\omega_T t)) \text{ where } \omega_T = 2\pi/T,$$
$$a_0 = \frac{2}{T} \int_0^T F(t) dt,$$
$$a_n = \frac{2}{T} \int_0^T F(t) \cos(n\omega_T t) dt, \text{ and}$$
$$b_n = \frac{2}{T} \int_0^T F(t) \sin(n\omega_T t) dt$$